AMENDMENTS

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In the Claims:

Please cancel claims 1-56.

Please add the following new claims 57-88:

57. (NEW) A method of generating a library of simulated-diffraction signals for an integrated circuit periodic grating, comprising:

generating sets of intermediate layer data,

wherein each set of intermediate layer data corresponds to a separate one of a plurality of hypothetical layers of a hypothetical profile of the periodic grating, and

wherein each separate hypothetical layer has one of a plurality of possible combinations of hypothetical values of properties for that hypothetical layer;

storing the generated sets of intermediate layer data; and

generating simulated-diffraction signals for each of a plurality of hypothetical profiles based on the stored generated sets of intermediate layer data.

58. (NEW) The method of claim 57, wherein generating sets of intermediate layer data comprises:

for each hypothetical layer:

setting permittivity parameters;

computing a wave-vector matrix, the wave-vector matrix being based on the permittivity parameters for the hypothetical layer; and

computing characteristic parameters for the wave-vector matrix computed for the hypothetical layer,

wherein the intermediate layer data for each hypothetical layer includes the characteristic parameters for the wave-vector matrix for that hypothetical layer.

59. (NEW) The method of claim 58, wherein generating sets of intermediate layer data comprises:

for each hypothetical layer:

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setting incident-radiation parameters,

wherein the wave-vector matrix is based on the incident-radiation parameters.

60. (NEW) The method of claim 57, wherein generating sets of intermediate layer data comprises:

for each set of intermediate layer data:

computing at least one of:

permittivity parameters including a permittivity, harmonic components of the permittivity, and a permittivity harmonics matrix; and

inverse-permittivity parameters including an inverse-permittivity, harmonic components of the inverse-permittivity, and an inverse-permittivity harmonics matrix;

computing a wave-vector matrix; and

computing eigenvectors and eigenvalues of the wave-vector matrix to form an eigenvector matrix, a root-eigenvalue matrix and a compound matrix,

wherein the stored intermediate layer data includes the wave-vector matrix corresponding to that intermediate layer data.

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61. (NEW) The method of claim 60, wherein generating simulated-diffraction signals comprises:

for each hypothetical profile:

constructing a matrix equation from the stored intermediate layer data corresponding to the hypothetical layers of the hypothetical profile, the matrix equation being a function of the stored eigenvector matrices, the computed root-eigenvalue matrices and the compound matrix;

solving the constructed matrix equation to determine a diffracted reflectivity value Ri for each harmonic order i; and

using the determined diffracted reflectivity values Ri to generate the simulated-diffraction signal for the hypothetical profile.

62. (NEW) The method of claim 57, wherein generating simulated-diffraction signals for each of a plurality of hypothetical profiles comprises:

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constructing a matrix equation from the stored intermediate data corresponding to the hypothetical layers of the hypothetical profile; and

solving the constructed matrix equation to determine diffracted reflectivity values for the hypothetical profile.

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63. (NEW) The method of claim 57, wherein generating simulated-diffraction signals for each of a plurality of hypothetical profiles comprises:

performing rigorous coupled-wave analysis on the saved intermediate data corresponding to the hypothetical layers of the hypothetical profile.

64. (NEW) The method of claim 57, wherein storing the generated sets of intermediate layer data comprises:

storing the intermediate layer data within a cache.

65. (NEW) The method of claim 64, wherein the cache resides in a computer memory.

66. (NEW) The method of claim 57, wherein generating simulated-diffraction signals comprises:

characterizing the shape of a hypothetical profile for the periodic grating with a set of profile parameters; and

varying the set of profile parameters to generate the plurality of hypothetical profiles.

67. (NEW) The method of claim 57, wherein generating simulated-diffraction signals comprises:

for each hypothetical profile,

retrieving the one or more stored intermediate layer data that characterizes the hypothetical profile; and

applying boundary conditions to generate a simulated-diffraction signal for the hypothetical profile.

68. (NEW) The method of claim 67 further comprising:

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pairing each hypothetical profile with the simulated-diffraction signal generated for that hypothetical profile, and

storing the hypothetical profile and simulated-diffraction signal pair.

69. (NEW) The method of claim 68, wherein the hypothetical profile and simulated-diffraction signal pair is stored in a computer-readable medium.

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70. (NEW) A method of generating a library of simulated-diffraction signals for an integrated circuit periodic grating, comprising:

generating sets of intermediate layer data,

wherein each set of intermediate layer data corresponds to one of a plurality of hypothetical layers of a hypothetical profile of the periodic grating;

storing the sets of intermediate layer data;

generating simulated-diffraction signals for a plurality of hypothetical profiles of the periodic grating based on the stored intermediate layer data; and

storing the simulated-diffraction signals.

71. (NEW) The method of claim 70,

wherein generating sets of intermediate layer data comprises computing a wave-vector matrix for each set of intermediate layer data, and

wherein storing the sets of intermediate layer data comprises storing the wave-vector matrix generated for each set of intermediate layer data.

72. (NEW) The method of claim 70, wherein generating simulated-diffraction signals comprises:

constructing a matrix equation from the stored intermediate layer data corresponding to the hypothetical layers of the hypothetical profile; and

solving the constructed matrix equation to determine diffracted reflectivity values for the hypothetical profile.

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73. (NEW) The method f claim 70, wherein generating simulated-diffraction signals comprises:

characterizing the shape of a hypothetical profile of the periodic grating with a set of profile parameters; and

varying the set of profile parameters to generate the plurality of hypothetical profiles.

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74. (NEW) The method of claim 73, wherein storing the simulated-diffraction signal comprises:

pairing each hypothetical profile with the simulated-diffraction signal generated for that hypothetical profile; and

storing the hypothetical profile and simulated-diffraction signal pair.

75. (NEW) The method of claim 70, wherein the intermediate layer data are stored in a computer memory, and wherein the simulated-diffraction signals are stored on a computer-readable medium.

76. (NEW) The method of claim 70 comprising:

illuminating a portion of a semiconductor wafer with incident radiation;

measuring a diffraction signal from the radiation diffracted from the portion of the semiconductor wafer; and

matching the measured diffraction signal with one of the stored simulated-diffraction signals.

77, (NEW) The method of claim 76, wherein the incident radiation includes light having a plurality of wavelengths, and wherein the portion of the wafer is illuminated from a single angle.

78. (NEW) The method of claim 76, wherein the incident radiation includes light having a single wavelength, and wherein the portion of the wafer is illuminated from a plurality of angles.

79. (NEW) A computer readable medium having a library of simulated-diffraction signals generated in accordance with the method of claim 70.

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80. (NEW) A method of using a library of simulated-diffraction signals to determine the profile of a periodic grating, the method comprising:

illuminating a portion of a semiconductor wafer with incident radiation;

measuring a diffraction signal from the radiation diffracted from the portion of the semiconductor wafer; and

matching the measured diffraction signal with one of a plurality of simulated-diffraction signals stored in a library of simulated-diffraction signals,

wherein the library of simulated-diffraction signals was generated in advance in accordance with the method of claim 70.

81. (NEW) A method of generating and using a library of simulated-diffraction signals of a periodic grating, the method comprising:

generating sets of intermediate layer data,

wherein each set of intermediate layer data corresponds to one of a plurality of hypothetical layers of a hypothetical profile of the periodic grating;

storing the sets of intermediate layer data;

generating simulated-diffraction signals for a plurality of hypothetical profiles of the periodic grating based on the stored intermediate layer data;

storing the simulated-diffraction signals;

illuminating a portion of a semiconductor wafer with incident radiation;

measuring a diffraction signal from the radiation diffracted from the portion of the semiconductor wafer; and

matching the measured diffraction signal with one of the stored simulated-diffraction signals.

82. (NEW) A system for generating a library of simulated-diffraction signals for a periodic grating, comprising:

a processor configured to generate sets of intermediate layer data,

wherein each set of intermediate layer data corresponds to a hypothetical layer of a hypothetical profile of the periodic grating;

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a memory configured to store the sets of intermediate layer data; and

wherein the processor is further configured to:

generate simulated-diffraction signals for a set of hypothetical profiles of the periodic grating based on the intermediate layer data stored in the memory.

83. (NEW) The system of claim 82, wherein the processor is further configured to compute a wave-vector matrix for each set of intermediate layer data, and wherein the wave-vector matrix is stored in the memory.

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84. (NEW) The system of claim 82, wherein the processor is further configured to:

construct a matrix equation from the stored intermediate layer data corresponding to the hypothetical layers of a hypothetical profile; and

solve the constructed matrix equation to determine diffraction reflectivity values for the hypothetical profile.

85. (NEW) The system of claim 82 further comprising:

a computer-readable medium configured to hold the generated simulated-diffraction signals.

86. (NEW) A computer-readable storage medium containing computer executable instructions for causing a computer to generate a library of simulated-diffraction signals of a periodic grating, comprising instructions for:

generating sets of intermediate layer data,

wherein each set of intermediate layer data corresponds to one of a plurality of hypothetical layers of a hypothetical profile;

storing the sets of intermediate layer data;

generating simulated-diffraction signals for a plurality of hypothetical profiles of the periodic grating based on the stored intermediate layer data; and

storing the simulated-diffraction signals.

87. (NEW) The computer-readable storage medium of claim 86,

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wherein generating sets of intermediate layer data comprises computing a wave-vector matrix for each set of intermediate layer data, and

wherein storing the sets of intermediate layer data comprises storing the wave-vector matrix generated for each set of intermediate layer data.

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88. (NEW) The computer-readable storage medium of claim 86, wherein generating simulated-diffraction signals comprises:

constructing a matrix equation from the stored intermediate layer data corresponding to the hypothetical layers of the hypothetical profile; and

solving the constructed matrix equation to determine diffracted reflectivity values for the hypothetical profile.

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